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*Part of Bureau of Standards Journal of Research, vol. 12, January 1934*DATA ON THE SPECTRAL ERYTHEMIC REACTION
OF THE UNTANNED HUMAN SKIN TO ULTRAVIOLET
RADIATION

By W. W. Coblentz and R. Stair

ABSTRACT

This paper gives a revision and an extension in spectral range of the data, previously published¹ on the spectral erythemic reaction of the untanned skin.

The erythemic reaction is a convenient and accurate indicator of the tolerance of the human skin to ultraviolet radiation. Hence, before irradiating large areas, a preliminary exposure should be made on a small area to determine the time to produce a minimum perceptible erythema, thus avoiding burns.

A knowledge of the spectral erythemic response is, therefore, of importance in evaluating the ultraviolet output of a lamp. By means of data on the spectral erythemic reaction on the skin and a simple physical measurement² of the radiant flux emitted by the lamp, it is possible to calculate the approximate time of exposure that may be made without causing severe burns on the average pigmented skin.

In a previous communication³ data were given on the spectral erythemic response of the untanned human skin to ultraviolet radiation, in the wave length range extending from 2482 to 3130 Å.

In the meantime Rüttenauer⁴ presented data on the erythemic response to filtered radiation of wave length 3261 Å, which he obtained from a low-pressure cadmium arc lamp. He found that the spectral erythemic response at 3261 Å is 0.003 to 0.004 that of the emission line at 2967 Å; and that this erythema has the property of changing rapidly into pigmentation. The color of the erythema and of the pigmentation is similar to that produced by sunlight.

Experiments seem to indicate that, in the spectral range where these two reactions are produced, the longer the wave length the greater appears to be the pigmentation⁵ relative to the erythemic reaction. Furthermore, since, for the long wave lengths, pigmentation begins before the erythema has disappeared (also there is a

¹ Coblentz, Stair, and Hogue, B.S.Jour. Research, vol. 8 (RP433), p. 541, 1932.

² Tests of a Balanced Thermopile and Filter Radiometer as a Standard Ultraviolet Dosage Intensity Meter, W. W. Coblentz, R. Stair, and J. M. Hogue, B.S.Jour. Research, vol. 8 (RP450), p. 759, 1932. Also see Acceptance of Sun Lamps, by the Council on Physical Therapy, Jour. Am. Med. Association, vol. 100, p. 1863, June 10, 1933.

³ See footnote 1.

⁴ Rüttenauer, Proc. IIe Congrès International de la Lumière, Copenhagen, p. 72, Aug. 18, 1932, published by Engelsen and Schroeder, Copenhagen.

⁵ Uhlmann, Strahlentherapie, 35, p. 361, 1930; also papers by Gutman (cited by Uhlmann), and by Hausser and Vahle, etc., cited in our previous publication, reference 1.

similarity in color of the skin for these two reactions) there is difficulty in deciding when the erythema has completely disappeared.

Because of the rapid formation of pigment (tanning) after exposure to the emission line at 3130 Å, the writers experienced difficulty in deciding when the erythema had completely disappeared. As a consequence, there was a possibility of overestimating the magnitude of the erythema reaction.

It is possible that Rüttenauer may have experienced a similar difficulty. Nevertheless, in spite of the smallness of the erythema reaction measured, Rüttenauer's data are useful in establishing the long wave-length limit of spectral erythemic reaction. Accepting his values, as given, the writers have extended their curve of spectral erythemic reaction to wave lengths longer than 3150 Å, previously published. Furthermore, to meet the needs for higher accuracy, they have made a further study of, and have revised, the previously published data, all of which are given in table 1. The new data in the spectral range of 3150 to 3300 Å have but little effect upon the evaluation of the erythemogenic efficiency of therapeutic lamps, given in previous papers.

TABLE 1

The relative spectral erythemic response of the untanned human skin, of average pigmentation, to equal amounts of radiant energy, based upon the measurements of Hausser and Vahle (spectrally homogeneous radiation, 1922 and 1927); of Luckiesh, Holladay and Taylor (filter method, 1930); of Coblentz, Stair, and Hogue, using (in 1931) spectrally homogeneous radiation, and (in 1932) heterogeneous radiation from a "cold quartz" mercury vapor lamp, having 98 percent of the erythemogenic radiation in the emission line at 2537 Å; and of Rüttenauer (IIe Internat. Congrès de la Lumière, Copenhagen, 1932) using the filtered cadmium line at 3261 Å. The asterisk (*) indicates emission lines of the mercury arc.

Wave length (angstroms)	Erythemic response	Wave length (angstroms)	Erythemic response
2,400.....	0.56	2,894*	0.25
2,446*.....	.57	2,900.....	.31
2,482*.....	.57	2,925*.....	.70
2,500.....	.57	2,950.....	.98
2,537*.....	.55	2,967*.....	1.00
2,576*.....	.49	3,000.....	.83
2,600.....	.42	3,022*.....	.55
2,654*.....	.25	3,050.....	.33
2,675*.....	.20	3,100.....	.11
2,700*.....	.14	3,130*.....	.03
2,753*.....	.07	3,150.....	.01
2,804*.....	.06	3,200.....	.005
2,850.....	.09	3,250.....	.003
2,857*.....	.10	3,300.....	.000

WASHINGTON, September 30, 1933.

